Assessment of Dam Safety
Coal Combustion Surface Impoundments (Task 3)
Draft Final Report – Version 1

Georgia Power Company
Plant Bowen

Cartersville, Georgia

redacted

redacted

Prepared for

Lockheed Martin
2890 Woodridge Ave #209
Edison, New Jersey 08837

September 14, 2009

CHA Project No. 20085.1000.1510

CHA

I acknowledge that the management units referenced herein:

- Plant Bowen Ash Pond

Has been assessed on May 26, 2009 and May 27, 2009.

Signature: _____

Malcolm D. Hargraves, P.E.
Senior Geotechnical Engineer
Registered in the State of Georgia

Signature: _____

Katherine E. Adnams, P.E.
Senior Geotechnical Engineer

Reviewer: _____

Warren A. Harris, P.E.
Geotechnical Operating Manager
Registered in the State of Georgia

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1.0 INTRODUCTION & PROJECT DESCRIPTION

1.1 Introduction

CHA was contracted by Lockheed Martin (a contractor to the United State Environmental Protection Agency) to perform site assessments of selected coal combustion byproducts surface impoundments (Project #0-381 Coal Combustion Byproducts Surface Impoundments/Dam Safety Inspections). As part of this contract, CHA was assigned to perform a site assessment of Georgia Power Company Plant Bowen, which is located in Cartersville, Georgia as shown on Figure 1 – Project Location Map.

CHA made a site visit on May 26 and 27, 2009 to perform visual observations and to inventory coal combustion surface impoundments at the facility, inspect the containment dikes, and to collect relevant information regarding the site assessment.

CHA engineers, Malcolm Hargraves, P.E. and Katherine Adnams, P.E., were accompanied during the site visit by the following individuals:

Company or Organization	**Name and Title**
Environmental Protection Agency	Javier Garcia
Georgia Power Company	Tanya Blalock, Environmental Affairs Manager
Georgia Power Company	Kenneth Duquette, Compliance Team Manager
Georgia Power Company	Nik Budney, Bowen Plant Compliance Manager
Georgia Power Company	Will McIntyre, Sr., Compliance Specialist
Georgia Safe Dams	Carey Anderson, Environmental Engineer
Southern Company	Gary McWhorter, P.E., Earth Science and Environmental Engineering
Troutman Sanders	Hollister Hill, Attorney
Southern Company	Ron Wood, P.G., Hydro Services

1.2 Project Background

Discharges from the Plant Bowen Ash Pond are under the jurisdiction of the Georgia Department of Natural Resources Environmental Protection Division (EPD). EPD issued Permit No. GA0001449 to the Georgia Power Company authorizing discharge under the National Pollutant Discharge Elimination System to the Euharlee Creek and Etowah River (Coosa River Basin) in accordance with effluent limitations, monitoring requirements and other conditions set forth in the permit. The permit became effective on November 9, 2007 and will expire on June 30, 2010.

The dike surrounding the impoundment is not under the jurisdiction of EPD. According to the National Inventory of Dams (NID), the Georgia State ID No. for the dike is 008-031-04136. According to the EPD Safe Dams Program, the dike has been classified as a "Category II" dam; meaning improper operation or dam failure would not be expected to result in probable loss of human life. Category II facilities are exempt from all of the Georgia dam safety regulations, thereby leaving the design, operation and maintenance standards up to the owner's discretion for best management practices. According to Safe Dams Program personnel, as a Category II dam, the dike is not held to any state recognized dam design standards. However, the flood plain below the dike is re-inventoried by the Safe Dams Program at least once every 5 years to check for changed conditions to assure the dike is properly classified. If changed conditions warrant a reclassification to Category I, meaning improper operation or dam failure would be expected to result in probable loss of human life, the dike itself would require a State permit and design and operation standards would be imposed."

redacted

1. Pay a fine to the Georgia Department of Natural Resources;

redacted

redacted

redacted

1.3 Site Description and Location

The main impoundment at Plant Bowen was created by construction of the main dike, which bounds the impoundment on the south and west sides, and the north dike, which bounds the impoundment on about two thirds of the north side. The remaining portions of the impoundment are contained by natural ground. The main and north dikes were originally constructed in 1968 creating a storage area of about redacted acres. In 1992 and again in 2001 Georgia Power developed Ash Stacking Plans to expand the capacity of the facility and transition from wet process disposal to dry disposal. These stacking plans were approved by Georgia Environmental Protection Division (GA EPD).

This transition to dry disposal was an engineered plan to reduce the impacts of the hydrostatic levels in the impoundment from impacting the underlying karst topography, which is more thoroughly discussed in Section 1.5 below. The result of this change in operations is an impoundment with only about redacted acres containing liquid and these areas have been lined with geosynthetic clay liners (GCL) or HDPE liners, and/or clay soil liners. The remaining redacted acres of the main impoundment contains the dry-stacked ash. The areas where liquid is contained is comprised of two ash dewatering cells, two gypsum settling ponds, and a water recycle pond.

The Bowen Power Plant's recycle water portion of the unit, which contains the largest volume of liquid, is about 2 miles upstream of Euharlee, Georgia by the stream channel. The perimeter ditch drains to the Euharlee Creek, which subsequently discharges into the Etowah River.

A map of the region indicating the location of the Plant Bowen Ash Pond identifying schools, hospitals, or other critical infrastructure located within approximately 5 miles down gradient of the Ash Pond is provided as Figure 2.

1.3.1 Other Impoundments

In addition to the coal combustion byproducts (CCB) disposal area, CHA also observed and/or was made aware of other impoundments at the Plant Bowen site. The largest of these impoundments occupies roughly redacted acres and contains water pumped from the Etowah River for use as cooling water in the Plant. Other much smaller impoundments capture and control storm water runoff in the coal pile area and the waste gypsum coal combustion by-product storage facility located to the east of the steam plant and cooling water pond. These impoundments store water intermittently, do not contain CCB and therefore, were not inspected as part of this project.

1.4 Previously Identified Safety Issues

redacted

1.4.1 2002 Release and Karst Topography

redacted

redacted

1.4.2 2008 Release and Revised Stacking Plan

redacted

1.4.3 2008 Sinkhole at North Dike

redacted

redacted

1.5 Site Geology

A summary of the regional geology was prepared redacted

Section 3.3 – Regional Geology of the report states that "The Plant Bowen Ash Pond lies within the Valley and Ridge physiographic providence about three to four miles north of the Cartersville Fault. The Cartersville Fault separates the late Precambrian-aged metamorphic rocks to the east and south from the Cambrian-aged sedimentary rocks to the north and west. The Ash Pond lies within an area mapped primarily as Knox Group undifferentiated. The Knox Group produces a characteristic orange to red clayey residuum, often cherty, that ranges in thickness from ten to a hundred feet or more."

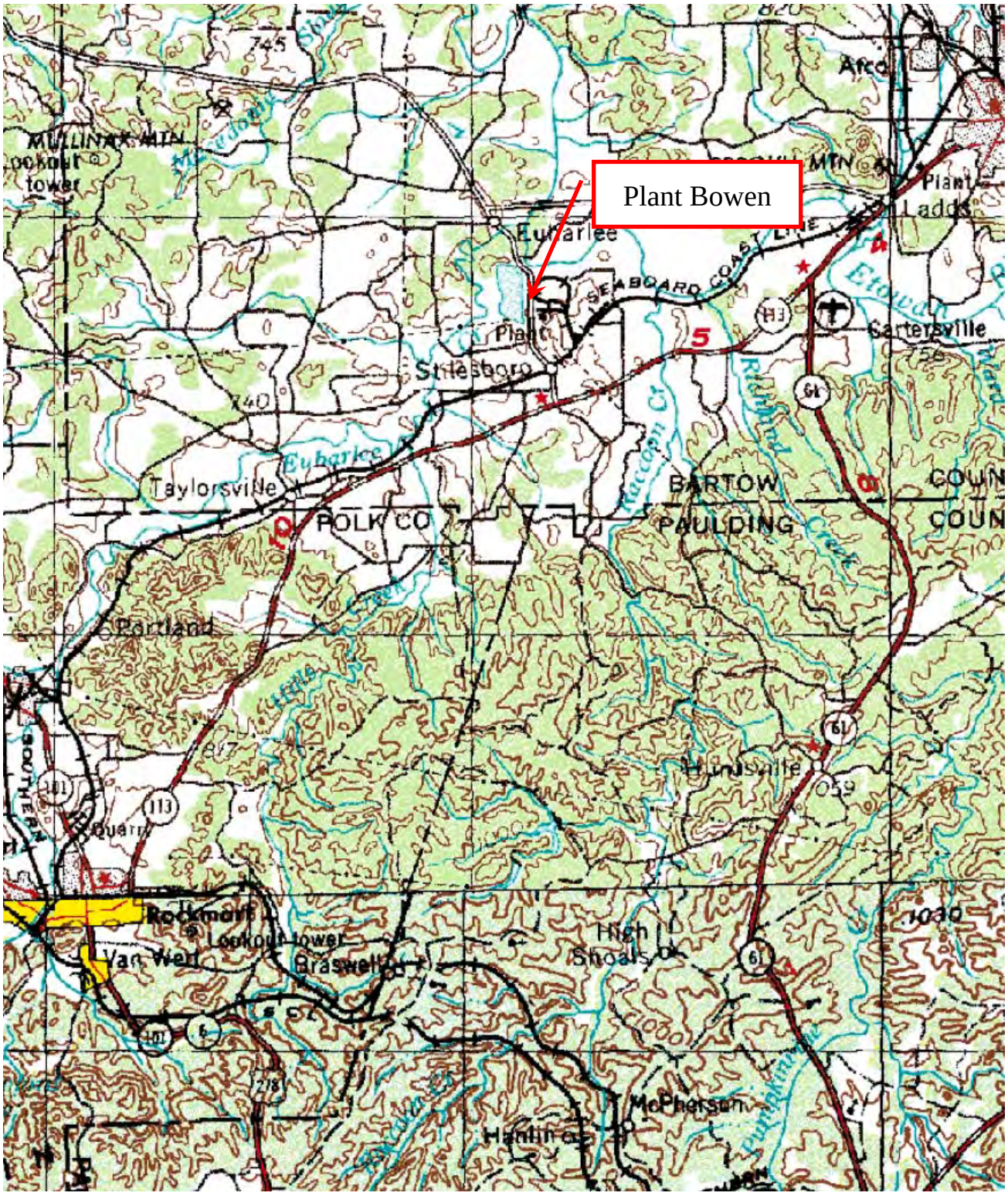
redacted

- Literature Review (Regional Geology)
- Arial Photography (Lineament) Studies
- Geophysical Surveys (Resistivity, Self Potential and Electromagnetic)
- Drilling, Sampling, Cone Penetrometer Testing, and Related Laboratory Analysis

Based on the investigations the report provides a description of the soil and rock (Section 3.7). The soils underlying the Ash Pond and embankment are residual, formed from the in-place weathering of the underlying dolomite and limestone. The soils were noted as varying from a fine, sandy clayey silt to silty clay. Permeability of the material was reported as varying from

about 1 x 10^{-6} to 1 x 10^{-8} cm/sec. Thickness was also found to vary from about 19 feet to 127 feet at the Plant Bowen site.

The report states that the carbonate rocks beneath the Ash Pond are typical of the Knox Group and that as part of various Plant Bowen studies, karst-controlling features such as lineaments and sinkholes were mapped across the site.



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CHA

Figure 1
Project Location Map

Scale: 1" = 2 miles	Project No.: 20085.1000.1510	Georgia Power Company Plant Bowen Cartersville, Bartow County, Georgia

IMAGE REFERENCE: GOOGLE EARTH, IMAGE DATE DECEMBER 19, 2005

0 1160 2320
Scale in feet

CHA

CRITICAL INFRASTRUCTURE MAP

PLANT BOWEN
GEORGIA POWER COMPANY
CARTERSVILLE, GEORGIA

PROJECT NO. 20085.1000
DATE: JULY 2009
FIGURE 2

2.0 FIELD ASSESSMENT

2.1 Visual Observations

CHA performed visual observations of the main and north dikes following the general procedures and considerations contained in Federal Emergency Management Agency's (FEMA's) *Federal Guidelines for Dam Safety* (April 2004), and Federal Energy Regulatory Commission (FERC) Part 12 Subpart D to make observations concerning settlement, movement, erosion, seepage, leakage, cracking, and deterioration. A Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Form, prepared by the US Environmental Protection Agency, were completed on-site during the site visit for the Ash Pond. Copies of the completed forms were submitted via email to a Lockheed Martin representative approximately three days following the site visit to Plant Bowen. Copies of these completed forms are included in Appendix A.

CHA's visual observations were made on May 26 and 27, 2009. The weather was cloudy with severe afternoon thunderstorms and temperatures between 64 and 82 degrees Fahrenheit. Prior to and during the days we made our visual observations, the following approximate rainfall amounts occurred (as reported by www.weather.com).

Table 1 - Approximate Precipitation Prior to Site Visit

Date of Site Visit - May 26, 2009 & May 27, 2009		
Day	**Date**	**Precipitation (inches)**
Tuesday	5/19/09	0.00
Wednesday	5/20/09	0.00
Thursday	5/21/09	0.05
Friday	5/22/09	0.00
Saturday	5/23/09	0.05
Sunday	5/24/09	0.00
Monday	5/25/09	0.03
Tuesday	5/26/09	0.94
Wednesday	5/27/09	0.06
Total	**Week Prior to Site Visit**	**1.13**
Total	**Month of May**	**7.71**

It should also be noted that localized, isolated thunderstorm activity was evident at the plant Monday mid-afternoon after the initial field walkthrough.

2.2 Embankments and Crest

The main dike is approximately redacted feet long, and the north dike is approximately redacted feet long. Two wet ash disposal ponds are contained within the main impoundment and consist of an exterior berm approximately redacted feet long, and a separator dike between the two ponds approximately redacted feet long. Also included in the main impoundment are two gypsum settling ponds with berms about redacted feet long each. The wet ash and gypsum ponds are lined with geosynthetic liners, and if a breach of one of those were to occur, the release would be contained within the main impoundment. Therefore, CHA performed only a cursory review of these structures.

2.2.1 Main Dike

In general, the main dike does not show signs of changes in horizontal alignment from the proposed alignment. No evidence of prior releases, failures or patchwork on the dike was observed at the time of the site visit. According to Georgia Power personnel, the crest is regraded as needed to fill in tire ruts thereby reducing ponding of storm water on the crest. The embankment is uniform and well covered with appropriate grass cover, which was freshly mowed during our site visit. The main dike was constructed with a downstream slope of redacted.

The southern portion of the main dike along the Recycle Pond consists of a redacted-foot high dike constructed on top of a redacted foot high natural cut slope. The natural slope throughout this area has several locations where surficial slides have occurred as shown in Photos 1, 2, 5 and 6. redacted

One feature, as shown in Photo 7, appeared more recent because of

relatively new erosion control matting. Southern Company personnel indicated this area had been reseeded several times without adequate vegetation growth, so the erosion matting was placed as an additional attempt to establish good grass growth.

In the area where the Recycle Pond ends and the main dike curves to the north, the cover soil over the formerly sluiced or placed ash is level with the crest of the dam as shown in Photos 15, 16, 18, and 20. The design width of the crest was redacted feet. This condition continues along the entire length of the main dike from the southwest curve to the north abutment. Although obscuring the upstream slope of the constructed dike and the upstream edge of the main dike crest, CHA did not observe conditions of concern along the crest of the main dike.

2.2.2 North Dike

In general, the north dike does not show signs of changes in horizontal alignment. No evidence of prior releases, failures or patchwork on the dike was observed at the time of the site visit. According to Georgia Power personnel, the crest is re-graded as needed to fill in tire ruts thereby reducing ponding of storm water on the crest. The embankment is uniform and well covered with appropriate grass cover, which was freshly mowed during our site visit. The north dike was constructed with a downstream slope of redacted.

The western portion of the north dike is adjacent to the active dry stack area as shown in Photos 24 and 25. These photos also show the configuration of the drainage swale between the north dike and the ash stack. Georgia Power personnel indicated the drainage swale in this area is being regarded to address drainage and conveyance of storm water. This work is expected to be completed in 2009 or 2010.

2.3 Outlet Control Structure and Discharge Channel

The only outlet control structure in the main impoundment is in the southeast portion of the impoundment, which is used as a Recycle Pond. The outlet is an emergency Ash Pond overflow

discharge point in the NPDES permit which discharges through a sampling flume into a discharge channel in natural ground (photo 1). The discharge channel flows west until it intersects the Euharlee Creek. This channel is relatively clear, although portions of the channel are being choked by soil previously sloughed from the adjacent natural slope as shown in Photos 4 through 7.

2.4 Monitoring Instrumentation

There are 60 piezometers installed along the main impoundment dikes, Recycle Pond, and dewatering cell dikes at Plant Bowen with the majority being monitored remotely. Summaries and a review of this data are included in Section 3.4.1. These piezometers are located in the embankments, existing ash, and in the bedrock underlying the site. redacted

1

redacted

South end of main dike at NPDES Sampling flume, looking west. The majority of the slope shown is a natural cut slope, redacted foot high embankment constructed to blend into slope in this area.

2

redacted

3

redacted

South end of the main dike, looking west. Note transition between natural cut slope and raised dike.

4

redacted

Perimeter
channel and h

5

redacted

Perimeter ditch at south end of main dike, looking west, 180 degree view of previous photo.

6

redacted

7 redacted

unch
has had

8 redacted

South portio ond is

9 redacted

South end of the west portion of the Dike.

10 redacted

South end of t about every
20

11

redacted

Embankment at the “Horseshoe” (looking south). Note the gravel at the toe which was placed during the grouting program to seal karst features below the embankment.

12

redacted

North end of Main Dike (looking north). Note: The gravel at the toe which was placed during the grouting program to seal karst features below the embankment.

13

redacted

Stone cover at North end of Main Dike placed during the grouting program
to seal karst features below the embankment. The white numbered concrete posts mark toe drain locations.

14

redacted

North end of Main Dike, looking south.

15 redacted

original emb sh pile.

16 redacted

Drainage swale between dike and dry stacked ash piles.

17 redacted

Surficial drainage system draining storm water runoff from ash stacks to the drainage swale.

18 redacted

19

redacted

Embankment at the “Horseshoe”, looking north. Gray coloring at toe of embankment is gravel placed along the road.

20

redacted

Embankment looking from the “Horseshoe”, looking south.

21

redacted

Recycle Pond and south end of the embankment crest looking east.
Note the Recycle Pond is lined with bentonite and HDPE liner.

22

redacted

Drainage Swale noted in Photos 15, 16, and 17 discharges into the Recycle Pond.
Note the drainage swale is also HDPE lined. Behind the swale in this photo is one of two gypsum ponds.

23

redacted

Crest of south end of main dike, looking east.

24

redacted

Upstream side of North Dike, looking east. Dry Stack ash piles in the right of the photo.
Drainage swale in this area is lined with clay, but additional work is planned for the 2009 construction season.

25

redacted

Overview of north dike, looking east.

26

redacted

West end of north dike, looking east.

27

redacted

Within the main impoundment looking north toward the dry stack area.

28

redacted

Within the main impoundment, looking south. To the left of photo
are the ash dewatering cells (2) and to the right of the photo are the gypsum dewatering cells (2).

29 redacted

30 redacted

North ash dewatering cell, looking east.

31

redacted

North embankment of ash dewatering cells.

32

redacted

North embankment of ash dewatering cells, looking east.

33

redacted

Separator dike between two ash dewatering cells.

34

redacted

South ash dewatering cell, looking east.

35

redacted

West embankment of south ash dewatering cell, looking south.

36

redacted

South embankment of ash dewatering cells, looking east. Note the lined drainage swale in right of photo discharges into the recycle pond.

37

redacted

Upstream slope of south embankment of ash dewatering cells, looking east. Note the red clay liner which overlays a liner.

38

redacted

East slope of ash dewatering cells, looking south.

39

redacted

Sluiceway into the north ash dewatering cell.

40

redacted

East slope of ash dewatering cells, looking south.

41

redacted

Lined gypsum dewatering cell.

42

redacted

Emergency overflow and outlet sluice (via buried outlet pipe) from
the gypsum dewatering cell into the drainage swale running to the recycle pond.

3.0 DATA EVALUATION

3.1 Design Assumptions

Design drawings from 1969 show that the dikes were generally homogenous structures comprising low permeability compacted fill supported above the natural soil, with a height ranging from redacted feet for the north dike to redacted feet for the west dike. The upstream and downstream slopes had redacted grades, which was fairly typical of that time period. Most critically, relative to the current condition in the pond, the dikes were to impound liquid borne, completely saturated, coal combustion byproducts (CCB). The required free board on the dikes would have been based on hydraulic and hydrology analyses for the impoundment. This historical information was not available at the time this report was written and current operating procedures at the site include only a small area of liquid borne CCB and the remaining portions of the site contain ash placed under hydraulic conditions, and stacks of dry ash.

3.2 Hydrology and Hydraulics

Georgia EPD classifies the Bowen Ash Pond as a Category II dam based on their criteria that a failure at this impoundment would not be likely to result in a loss of life. As a Category II facility, Georgia regulations exempt the dam from the dam safety regulations.

Despite being exempt from the dam safety regulations, Southern Company provided CHA with an evaluation of the drainage from the Ash Pond site (including the dry stack area, wet process ponds, and gypsum ponds) during a 10-year, 24-hour storm event. The volume of runoff from this storm can be completely stored in the Recycle Pond. This storage ability was based on the normal operating pool elevation of the Recycle Pond.

In addition, the there are two methods of discharge from the Recycle Pond. The first discharges to the Etowah River through the NPDES permitted outlet. The second is a former discharge point that is still in place, and discharges to the Euharlee Creek. According to Southern

Company this outlet requires manual operation. This is a permitted discharge under the NPDES permit during emergency conditions.

3.3 Structural Adequacy & Stability

The Georgia Department of Natural Resources Environmental Protection Division outlines rules and regulations for dam safety in Standards for the Design and Evaluation of Dams (391-3-8-.09). The regulations state that all dams must be stable under all conditions of construction and/or operation of the impoundment. Analyses using the methods, guidelines and procedures of the agencies listed in the regulations yielding the minimum safety factors shown in Table 2 for earthen embankments can be considered as acceptable stability.

Table 2 - Minimum Safety Factors Required

Load Case	Required Minimum Factor of Safety
End of Construction	1.3
Steady State Seepage	1.5
Steady State Seepage with Seismic Loading	1.1
Rapid Drawdown (Upstream)	1.3
Submerged Toe with Rapid Drawdown	1.3

redacted

3.3.1 Main and North Dikes

redacted

redacted

Table 3 - 1969 Soil Strength Parameters

Soil Stratum	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)	Description
A	122	redacted	1,000	Embankment
B	128	redacted	500	Natural Subgrade
C	115	redacte	250	Natural Subgrade
C_1	115	redacted	500	Natural Subgrade (consolidated)
D	120	redacted	1,500	Natural Subgrade
E	120	redacte	1,000	Natural Subgrade

Two of the four strata were modeled below the west dike location while three of the four strata were modeled beneath the north dike. A stability cross-section of the north dike structure (Sta. redacted) assuming steady-state conditions and a full hydrostatic head at Elevation redacted was modeled.

redacted

Table 4 - 2003 Soil Strength Parameters (Steady State)

Description	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)
Embankment	122	redacted	350
Firm Residual Soil	124	redacted	218
Weak Residual Soil	117	redacted	100
Ash	85	redacted	0

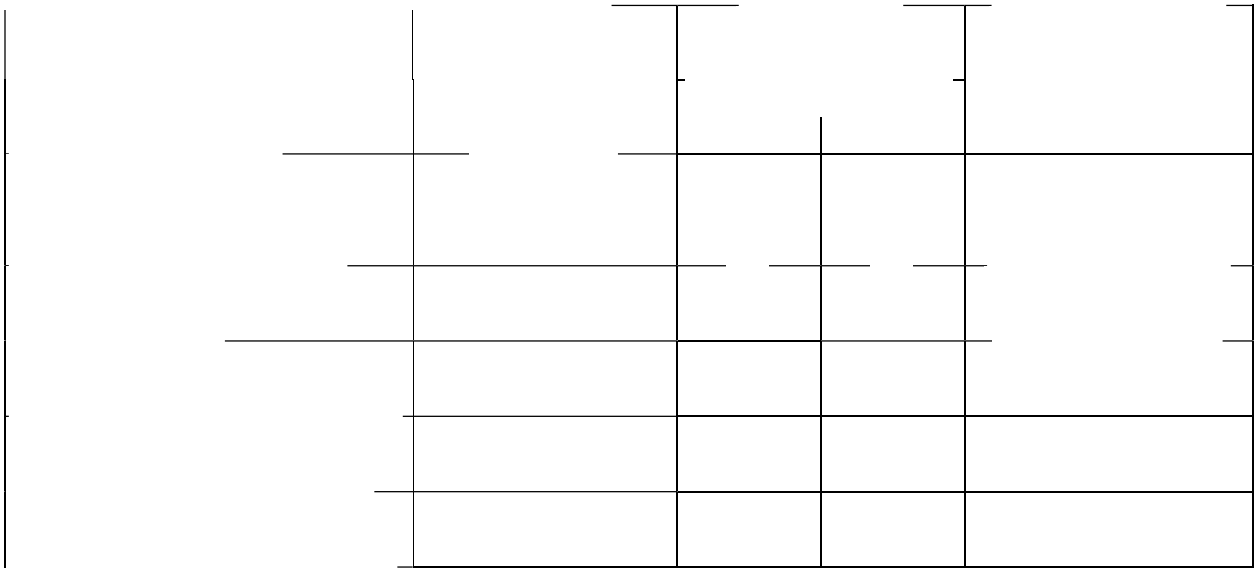
redacted

Table 5 - 2003 Soil Strength Parameters (Earthquake)

Description	Unit Weight (pcf.)	Friction Angle (φ)	Cohesion (psf)
Embankment	122	redacted	280
Firm Residual Soil	124	redacted	175
Weak Residual Soil	117	redacted	100
Ash	85	redacte	0

Computed steady state safety factors ranged from 1.4 to 1.5 and the seismic safety factors ranged from 0.99 to 1.1. redacted

redacted



NP: Not performed

* 1) Degraded soil strength refers to strength of the soil being reduced or degraded by 20% to simulate loss in soil strength during seismic shaking.
  2) 2% PE means this level of quake has a 2% probability of exceedance (or 2% chance of higher magnitude earthquake occurring) within a 50-year period.

** For this section and case weak zone undrained cohesion varied until FOS approached or equaled 1.0. This yields a 'c' value of approximately 600 psf. This c=600psf then taken as lower bound strength of weak zone (lowest strength weak zone could exhibit without failure) and applied to other section geometries for this parameter evaluation.

*** Post-seismic refers to a period of time shortly after a seismic event, say 3 to 6 months, in which soil strength has not recovered from its 20% degraded values.

3.3.2 Wet Ash and Gypsum Dikes

Since the 2003 slope stability report was completed, Plant Bowen has completed its change to a dry stack operation, greatly reducing the wet CCB processing area to two small dewatering cells and two gypsum settling ponds. These are diked, GCL or HDPE lined basins constructed from compacted bottom ash and capped with natural soil. The ash dewatering cells are constructed with a redacted foot wide crest, redacted slopes, and are about redacted feet in height.

Southern Company provided CHA with analyses for the dewatering cells, and the resulting factors of safety for steady state and seismic conditions are summarized in Table 7. Rapid drawdown is not required for these because the dikes are lined with geosynthetic liners. Therefore, there are not hydrostatic pressures within the embankment.

CHA performed a sensitivity analysis of these structures with slightly lower embankment and immediately underlying ash strength properties based on our review of properties used at multiple ash ponds under steady state and seismic conditions. The results of CHA's analyses are also listed in Table 7 and show factors of safety meeting industry accepted standards.

Table 7- Safety Factors – Dewatering Cells

Load Case	USACOE Minimum Factor of Safety Guidelines	Southern Company Analysis		CHA Stability Analysis	
		Downstream Slope	Upstream Slope	Downstream Slope	Upstream Slope
End of Construction	1.3				
Steady State Seepage	1.5	1.8 (shallow) 2.7 (deep)	2.5 (deep)	1.9	4.6 (shallow)
Steady State Seepage with Seismic Loading	1.0	1.1 (shallow) 1.6 (deep)	1.1 (shallow) 1.4 (deep)	1.5	
Rapid Drawdown (Upstream)	1.3	N/A	N/A	N/A	N/A

Although the gypsum cells are slightly higher (about redactec feet), their side slopes are redacted Based on CHA analyses, the factors of safety for the gypsum cells is similar to that of the ash dewatering cells.

redacted the completed compaction grouting program under the west dike to strengthen foundation soils, the change from a wet to dry process disposal operation that continues to lower the overall piezometric levels in the pond, and a slope stability analysis of the present liquid CCB basins, the dikes appear structurally adequate.

3.4 Foundation Conditions

Documents reviewed by CHA indicate that the Ash Pond embankment was not constructed on wet ash, slag or other unsuitable materials. We did however note that several borings advanced in 2002 encountered material with Standard Penetration Test or N-Values equal to the weigh-of-rods and 1 to 2 inches of weathered limestone. Cone Penetration Tests confirm this soft layer. Stability models reviewed by CHA include a "weak residuals" layer in the analysis.

CHA was not provided with documentation of foundation preparation.

3.5 Operations & Maintenance

redacted

Georgia Power began transitioning to dry ash stacking instead of sluicing wet ash into the main impoundment in 1992. Between 1992 and 2002, about 6 to 12 inches of water was maintained on the surface of the ash for dust control purposes. Following the 2002 release of ash through karst below the main dike, Georgia Power changed their process of dust control to include placing moist (but not saturated) CCB, limiting the exposed area of ash, using temporary cover soil, and temporarily sealing exposed areas with a smooth drum roller. redacted

redacted

redacted

3.5.1 Piezometers

redacted

. The data is transmitted to Southern Company for interpretation. Georgia Power is working on installing a new remote reading system so selected piezometers will be able to be read daily.

redacted

3.5.2 Inspections

redacted

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Acknowledgement of Management Unit Condition

I acknowledge that the management unit reference herein was personally inspected by me and was found to be in the following condition: **Satisfactory.**

redacted

Based upon the information obtained during this investigation, the Bowen Steam Plant has an effective monitoring and inspection program for this unit.

4.2 Hydrologic and Hydraulic Recommendations

CHA recommends that the hydrology of the site be evaluated and operating procedures developed for a larger storm than the 10-year storm, which can be stored with no discharge in the recycle pond. Even though the basin is no longer used for wet ash storage, inundation from storm water runoff and/or breach of wet ash or gypsum ponds is contained within the original impoundment could result in overtopping of the main dikes resulting in embankment failure and a subsequent release of ash. Best Management Practice should be used to consider a reasonable design storm in combination with Georgia Power's tolerance for risk of this type of event occurring.

4.3 Stability Recommendations

Two stability conditions evaluated by Southern Company produce lower bound factors of safety. The first is under seismic loading, the factor of safety for the main embankment ranges from 0.99 to 1.1 for events ranging from 2% to 10% chance for exceedance in 50 years. The other condition is a Southern Company defined condition of uplift and reduced strength from a seismic

event occurring at about the same time, which is a reasonable consideration for the site specific conditions.

CHA recommends that immediately following seismic events resulting in 25% of the peak ground acceleration for a 500-year earthquake (i.e., 10% chance for exceedance in 50 years), Southern Company perform a site inspection and thorough review of instrumentation data in anticipation of changing conditions within the karst terrain.

4.4 Inspection Recommendations

CHA recommends that Georgia Power and Southern Company continue the redacted that have been implemented for the Ash Pond. This type of inspection allows for proactive responses to developing situations, which can reduce the risk of damaging releases or failures from occurring.

5.0 CLOSING

The information presented in this report is based on visual field observations, review of reports prepared by Southern Company Services, Inc. and this limited knowledge of the history of the Plant Bowen Ash Pond. The recommendations presented are based, in part, on project information available at the time of this report. No other warranty, expressed or implied is made. Should additional information or changes in field conditions occur the conclusions and recommendations provided in this report should be re-evaluated by an experienced engineer.

APPENDIX A

Completed EPA Coal Combustion Dam Inspection Checklist Form

&

Completed EPA Coal Combustion Waste (CCW) Impoundment Inspection Form

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Bowen Steam Plant	Date: May 26, 2009
Unit Name: Ash Disposal Pond	Operator's Name: Georgia Power
Unit I.D.:	Hazard Potential Classification: High Significant Low
Inspector's Name: Katherine Adnams/Malcolm D. Hargraves	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	quarterly		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?	redacted		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	n/a		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	n/a		Is water entering inlet, but not exiting outlet?	n/a	
5. Lowest dam crest elevation (operator records)?	redacted		Is water exiting outlet, but not entering inlet?	n/a	
6. If instrumentation is present, are readings recorded (operator records)?	x		Is water exiting outlet flowing clear?	n/a	
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	n/a		From underdrain?		x
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?		x
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	n/a		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?	n/a	
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?	x		24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments
	Note that the Hazard Potential Classification is based on the EPA classification prior to the site visit.
redacted	
	redacted
17,18	Scarps and sloughing, now healed, are noted in natural creek slopes below the berm at the south-east end. These are reportedly unchanged in at least the last 10 years.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # GA 0001449 INSPECTOR Adnams/Hargraves
Date May 26, 2009

Impoundment Name Bowen Power Plant Ash Pond
Impoundment Company Georgia Power
EPA Region 4
State Agency (Field Office) Addresss _____

Name of Impoundment Bowen Power Plant Ash Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update x

	Yes	No
Is impoundment currently under construction?	_____	x
Is water or ccw currently being pumped into the impoundment?	x	_____

IMPOUNDMENT FUNCTION: Dry Ash Stacked Storage, Gypsum Dewatering, Water Recycle

Nearest Downstream Town : Name Euharlee, Georgia
Distance from the impoundment 2 miles
Impoundment
Location: Longitude _____ Degrees _____ Minutes _____ Seconds
Latitude _____ Degrees _____ Minutes _____ Seconds
State _____ County _____

Does a state agency regulate this impoundment? YES _____ NO x

If So Which State Agency?_____

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

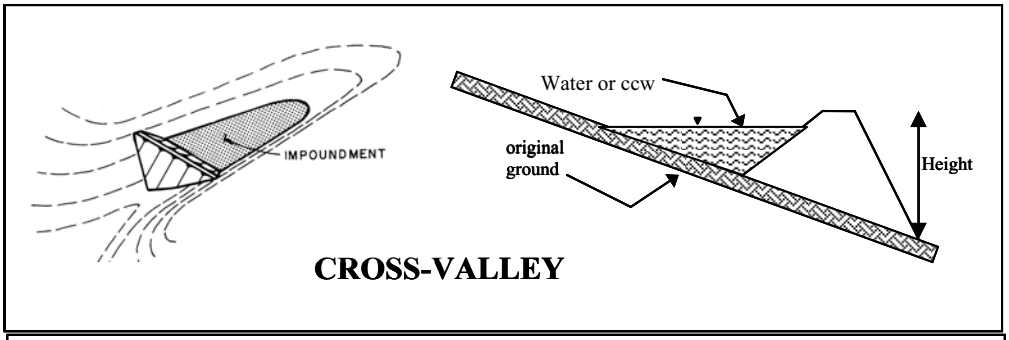
x_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

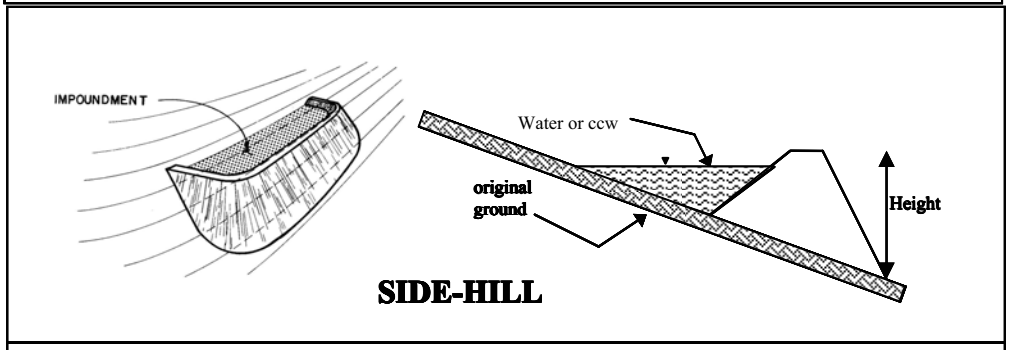
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

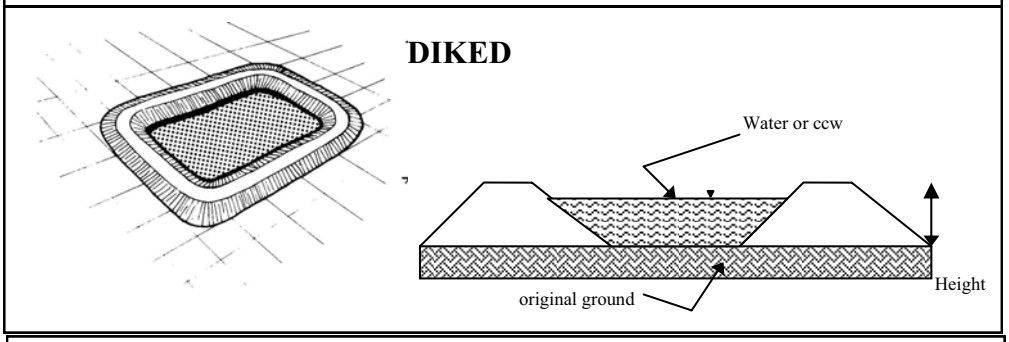
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

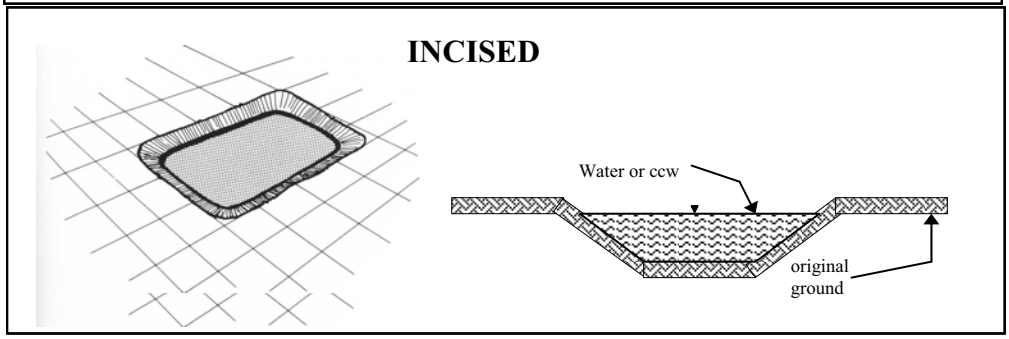
There is essentially little to no water-borne waste being retained in the ash "Pond". Essentially, the term "disposal pond" is misleading with respect to the function of the disposal operations. The hazard potential is primarily related to the karst topography evident below the disposal pond, the feature that eventually led to the change in operation from wet to dry storage/disposal. Any unpermitted releases would primarily be through the bottom of the disposal basin site, via karst solution features that can develop, most probably with notable fluctuations in groundwater table elevations in the bedrock and weathered bedrock formation. As such, any such damage would be environmental, associated with the coal combustion waste chemistry. Georgia Power Company has taken actions to reduce the risk of sinkhole activity by removing the hydraulic head on the dry ash stacking area of the pond and lining all dewatering areas, drainage swales and the recycle pond.

CONFIGURATION:







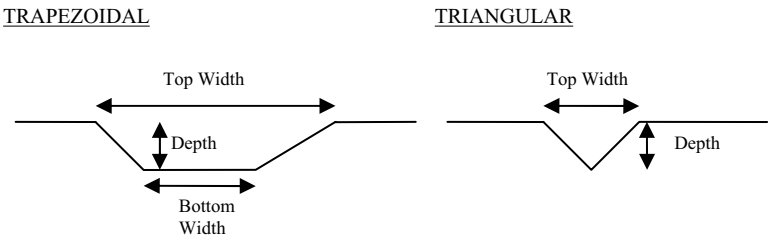


_____ Cross-Valley
x_____ Side-Hill
_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

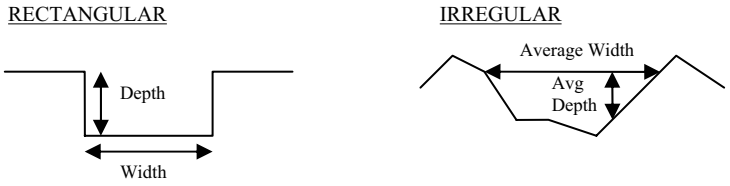
Embankment Height [redacted] _____ feet Embankment Material Native Borrow
Pool Area _____ acres Liner HDPE (Recycle Pond), GCL, clay/silt
Current Freeboard n/a_____ feet Liner Permeability _____

TYPE OF OUTLET (Mark all that apply)

n/a **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

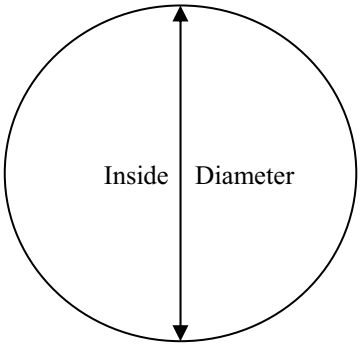


_____ depth
_____ bottom (or average) width
_____ top width
_____



n/a **Outlet**

_____ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _____

_____

Is water flowing through the outlet? YES _____ NO _____

n/a **No Outlet**

_____

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By Southern Companies/Georgia Power
_____

Has there ever been a failure at this site? YES _____ NO X *

If So When? 2002, 2008

If So Please Describe : redacted

Has there ever been significant seepages at this site? YES x NO _____

If So When? piezometers/dry stacking

IF So Please Describe: _____

redacted

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES x NO _____

If so, which method (e.g., piezometers, gw pumping,...)? piezometers/dry stacking

If so Please Describe :

The Bowen Power Plant has lined the recycle pond and the gypsum dewatering basins, and dewaters the CCB before stacking it in a dry state within the disposal area. A remote, automatic piezometer monitoring system is currently being installed and re-configured as construction and dry stack disposal activities continue in the facility.